Greenstar Plus
Hybrid System

NEW

WORCESTER
Bosch Group

Worcester and you, making a difference

As part of the Bosch Group, Worcester products are designed and manufactured to provide customers with the highest levels of quality and reliability which are synonymous with the Bosch name throughout the world.

As part of Europe's largest supplier of heating products, Worcester, Bosch Group has the UK-based resources and support capability to offer you the value-added solutions needed to drive your business forward. Worcester employs a nationwide network of Service Engineers and technically trained Field Sales Managers supported by an experienced award winning technical services team which is able to provide comprehensive support and advice from designing system layouts through to installation.

Worcester is dedicated to providing energy efficient gas- and oil-fired condensing boilers, as well as an extensive range of renewable technologies. All of our products have been developed and introduced with the aim of reducing climate change, helping the UK to achieve the Government's efficiency targets.

BOSCH
Invented for life

The reception and main entrance at our Worcester headquarters

"At Worcester we recognise the vital role you play in the specification and installation of energy efficient appliances in homes across the UK. We will continue to invest in our products, people, facilities and support services to ensure you can continue to deliver only the best solutions to your customers' requirements."

Carl Arntzen,
Managing Director,
Bosch Thermotechnology Ltd.

Contents **Page**

The Greenstar Plus Hybrid System	4 - 5
Features and benefits of the Greenstar Plus Hybrid System	6
Principles of operation	7
System layouts	8 - 9
Greenstar Plus Hybrid External Unit and technical data	10
Greenstar Plus Hybrid Manager and technical data	11
Greenstar Plus Hybrid FW200 weather compensation controller	12
Functional description of the Greenstar Plus Hybrid Manager	13
Is a Greenstar Plus Hybrid system suitable for the property?	14
Worcester Greenstar boilers compatible with a Greenstar Plus Hybrid system	15
Installing a Greenstar Plus Hybrid system	16 - 17
Installation and maintenance	18 - 20
Commissioning considerations	21
Greenstar Plus Hybrid system components and accessories	22
The very best training programmes from Worcester	23
Worcester training courses	24 - 25
A complete after-sales service	26

The Greenstar Plus Hybrid System

As part of the Bosch Group, Worcester is committed to innovation and environmental protection. Product development is prioritised in the interests of people's safety, the economical use of resources and environmental sustainability.

Worcester, Bosch Group has taken the lead in developing heating and hot water solutions that reduce the impact on the environment by reducing harmful CO_2 emissions, while continuing to satisfy the demand for domestic heating and hot water comfort – not only for today, but also for the future.

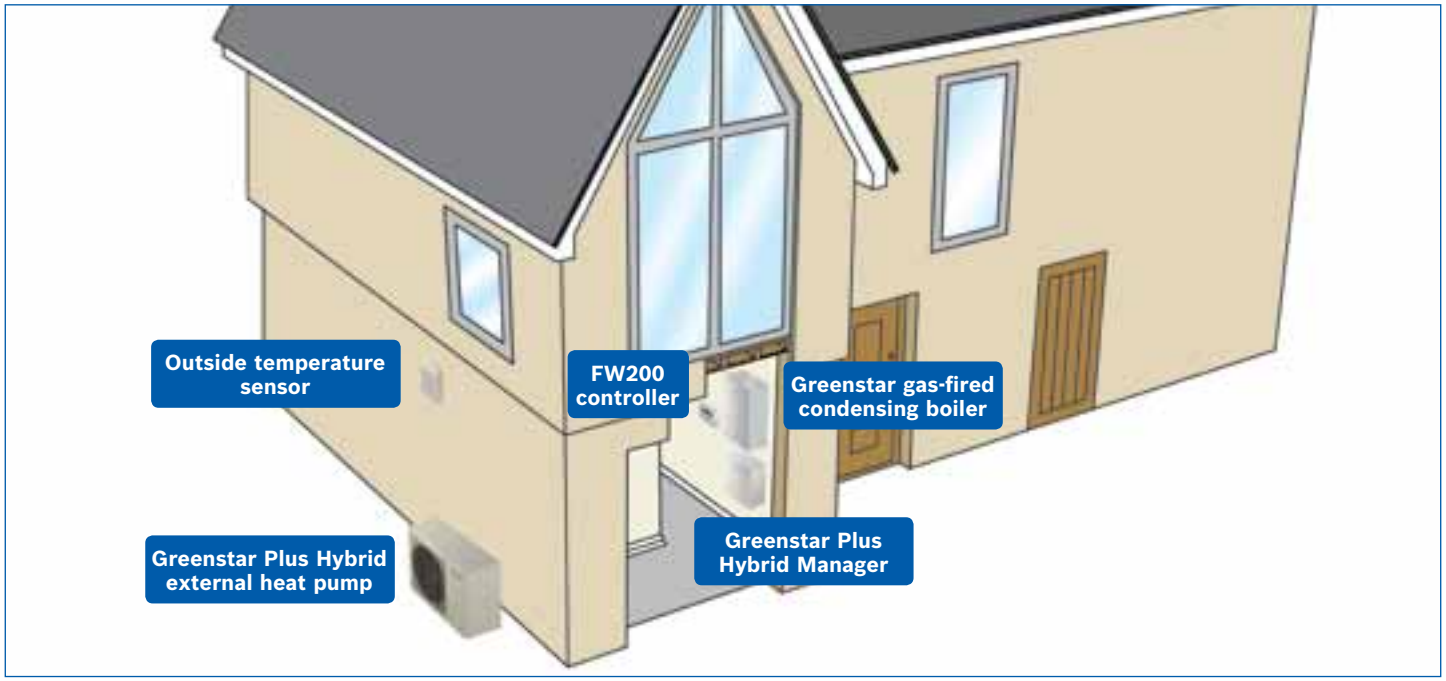
With this in mind, Worcester is proud to offer an efficient renewable Hybrid system that combines advantages of both a gas boiler and split air to water heat pump.

About the Greenstar Plus Hybrid System

The new Greenstar Plus Hybrid System, that **works in conjunction with selected Greenstar EMS gas-fired or LPG condensing boilers**, consists of a 5kW external heat pump and an indoor Hybrid manager. In combination with the FW200 intelligent control provided, the Worcester Hybrid System calculates which is the most efficient ratio between the external heat pump and the Worcester Greenstar gas-fired condensing boiler for reducing heating costs, CO_2, or a combination of both.

The Hybrid system is particularly suitable as a retrofit into a wide variety of property types and sizes, for homeowners seeking a cost-effective heating solution that can be combined with their existing Worcester, Bosch Group EMS (Energy Management System) natural gas or LPG boiler. Overall, the Hybrid system provides an easy to install solution for integrating renewable energy within an existing heating system and can also be combined with Solar.

System components



How does the Greenstar Plus Hybrid System work?

The Greenstar Plus Hybrid System aims to reduce running costs and increase CO_2 savings. Once the fuel tariffs have been inputted into the control unit, the Greenstar Plus Hybrid System calculates and controls the optimal fuel efficiency between the Worcester gas-fired boiler and the electric air to water heat pump.

Greenstar Plus Hybrid Manager

The intelligent Greenstar Plus Hybrid Manager combines the Worcester EMS gas-fired condensing boiler and external heat pump. This innovative software within the Hybrid Manager automatically ensures, at all times, the most efficient operation mode between both energy sources depending on the chosen strategy from the FW200 weather compensation controller.

The FW200 strategy consists of the following:

- Strategy 1: Cost optimised
- Strategy 2: CO_2 optimised
- Strategy 3: Changeover temperature
- Strategy 4: CO_2: cost mix.

Greenstar Plus Hybrid External heat pump

The external heat pump collects and transfers the available heat from the outside air to inside the property. As well as being fuelled by the free and inexhaustible supply of latent energy, the external heat pump offers a number of advantages, such as ease of installation and siting, while being suitable for a wide variety of property types and sizes. At a time when fuel costs are rising, the external heat pump gives the homeowner the opportunity to help reduce their heating bills. For more information on whether this system is suitable for your property, see page 12.

Please note: The heat pump must be installed by a qualified refrigerant engineer.

Greenstar Plus Hybrid System at a glance

	Greenstar Plus Hybrid package
Part No. (see page 22 for individual components)	7 716 162 025
Maximum boiler heating output[1)]	25kW
Mains power supply	230V, 1PH AC 50Hz
Refrigerant type[2)]	R410A
Refrigerant mass	2.5kg
Pipe for liquid refrigerant, external diameter	1/4"
Pipe for gaseous refrigerant, external diameter	1/2"

1) At 20 K (ΔT) between the heating system flow and return relative to a system pressure drop of 200mbar. Please note larger boiler outputs can be fitted.
2) GWP_{100} = 1980

Features and benefits of the Greenstar Plus Hybrid System

Greenstar Plus Hybrid Manager

External heat pump

Homeowner benefits

- Future proof – fulfilment of proposed future legislation and possible future subsidies to be gained
- Easy integration of renewable energy – new or existing EMS boiler can quickly and easily be upgraded
- Solar solution – can be combined with solar thermal technology
- CO_2 reduction – Both internal and external units operate in optimised mode
- Reduction of annual running costs – the Hybrid system is based on two different energy sources and operates through an intelligent control strategy
- Reduced energy costs – the external heat pump is fitted with a low energy circulation pump (LECP)
- Quiet operation – 46dB(A)
- Weather compensation control for improved heating control
- Bosch quality and reliability
- Two years' parts and labour guarantee*.

Installer benefits

- Simple to install and maintain – as little as 4 new components needed to upgrade to a renewable system (external heat pump, Hybrid manager, 50l buffer cylinder and an FW200 controller to an existing Worcester EMS boiler)
- Easy installation for a high efficiency system – time saving compared to other renewable technologies and does not require any complicated installation practice
- Compatible with a range of Worcester gas-fired NG or LPG boilers – can be combined with different Greenstar EMS boilers
- Compact in design for both the indoor and external unit
- Flexible design options – suitable for a wide variety of property types
- Easy to maintain – quick access to components
- Annual servicing not required on heat pump – only 2.5kg of refrigerant
- Technical support and training from Worcester – comprehensive knowledge and facilities from the market leader in domestic heating and hot water systems.

*Terms and conditions apply.

Principles of operating the Greenstar Plus Hybrid Manager

1. Data is inputted into the FW200 controller
   - Calculation of system flow set temperature
   - The appropriate strategy is chosen
     - Strategy 1: Cost optimised
     - Strategy 2: CO_2 optimised
     - Strategy 3: Changeover temperature
     - Strategy 4: CO_2: cost mix.
   - Enter energy price ratio electricity/gas

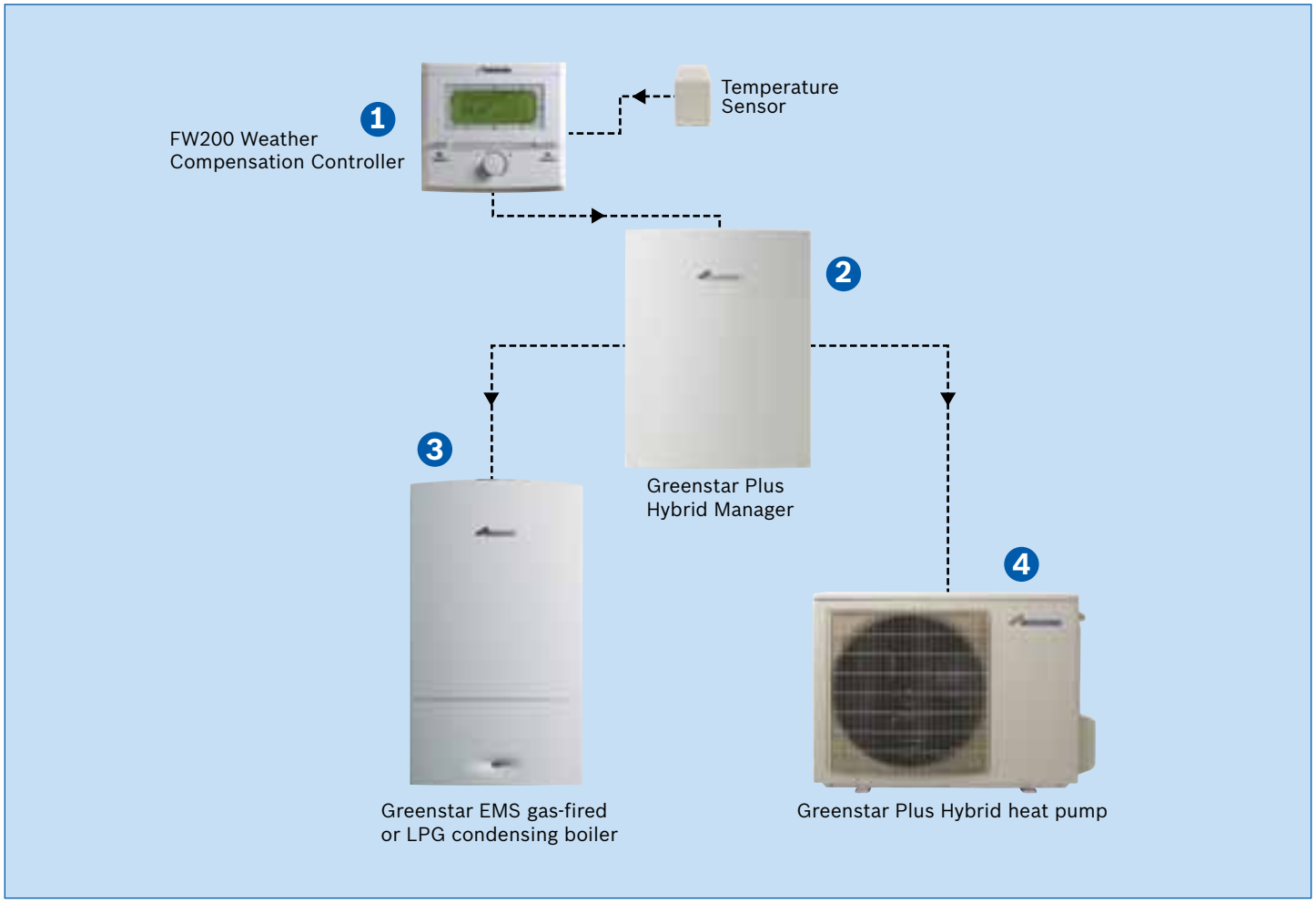
2. Greenstar Plus Hybrid Manager:
   - Calculation of flow set temperature for the heat pump
   - Calculation of flow set temperature for the boiler

3. Boiler: (the higher temperature heating option)
   - Supports central heating up to the calculated flow set temperature for the system or supports all DHW demand. Alternatively it can remain turned off.

4. Heat pump: (the lower temperature heating option)
   - Supports central heating up to the calculated flow set temperature for the heat pump (boiler turns on to reach peak demand) or supports 100% of the central heating up to the required system flow set temperature (so the boiler remains turned off). Alternatively the heat pump can remain turned off.

Function:
Based on required system flow set temperature, ambient temperature, energy price ratio and/or primary energy factors the overall highest possible system efficiency is calculated.

Interaction between the Greenstar Plus Hybrid system

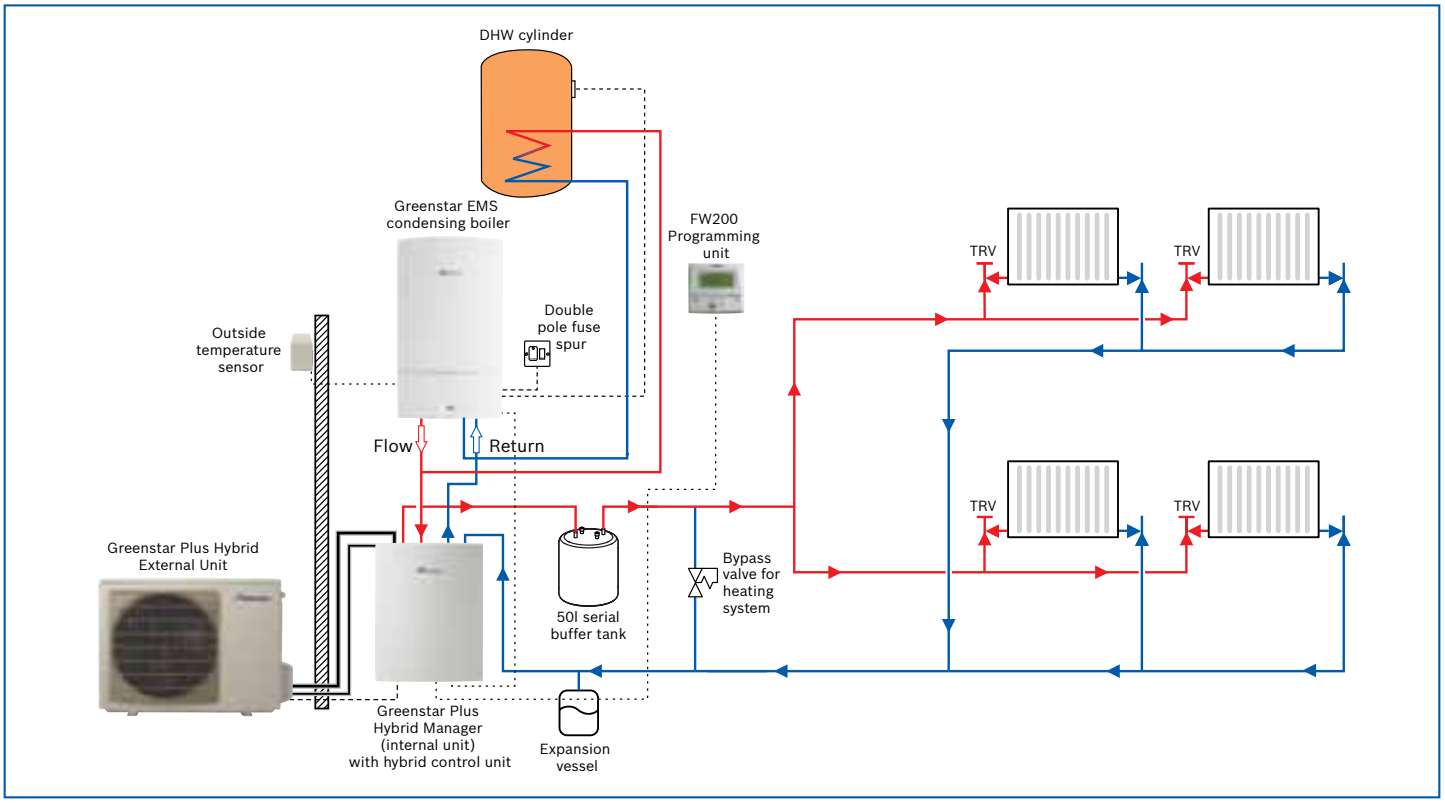


Examples of system layouts

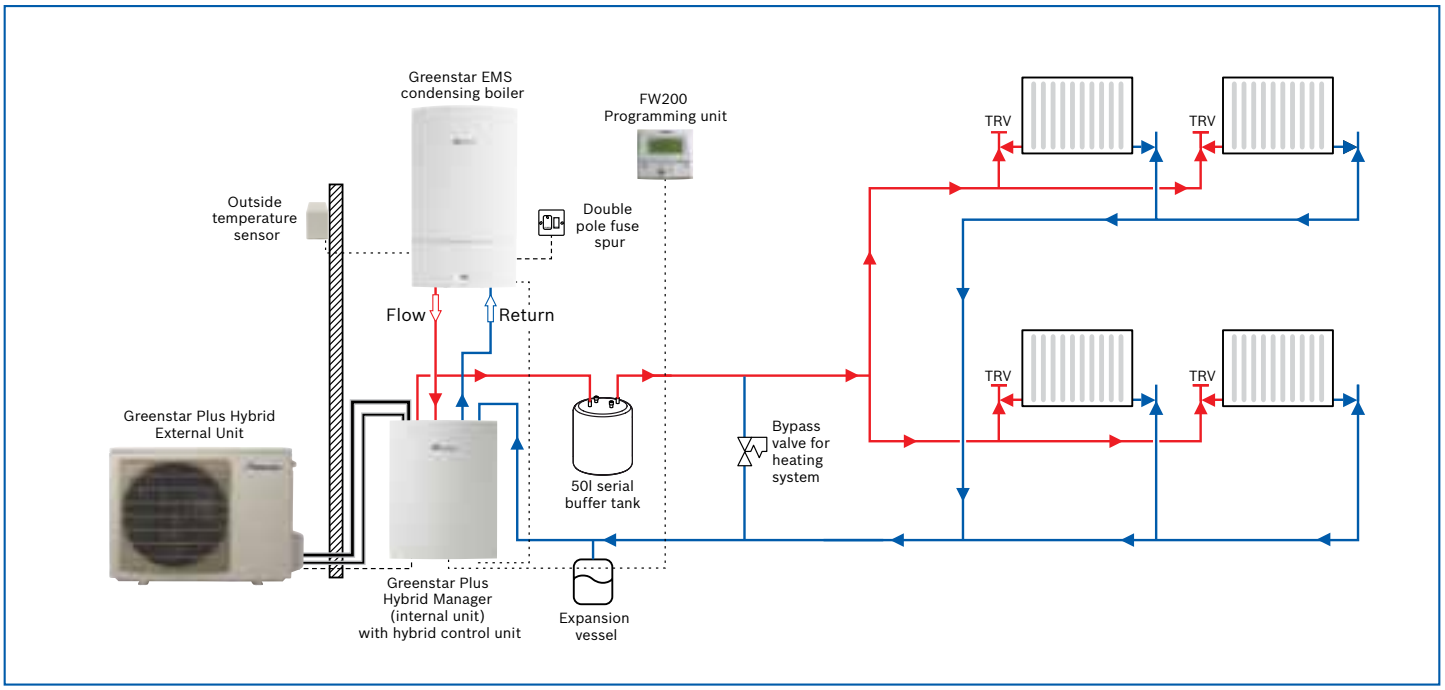
The Greenstar Plus Hybrid has been developed to allow installers flexibility with a range of heating systems. The diagrams below illustrate a few examples of this.

Internal diverter valve required in the boiler.

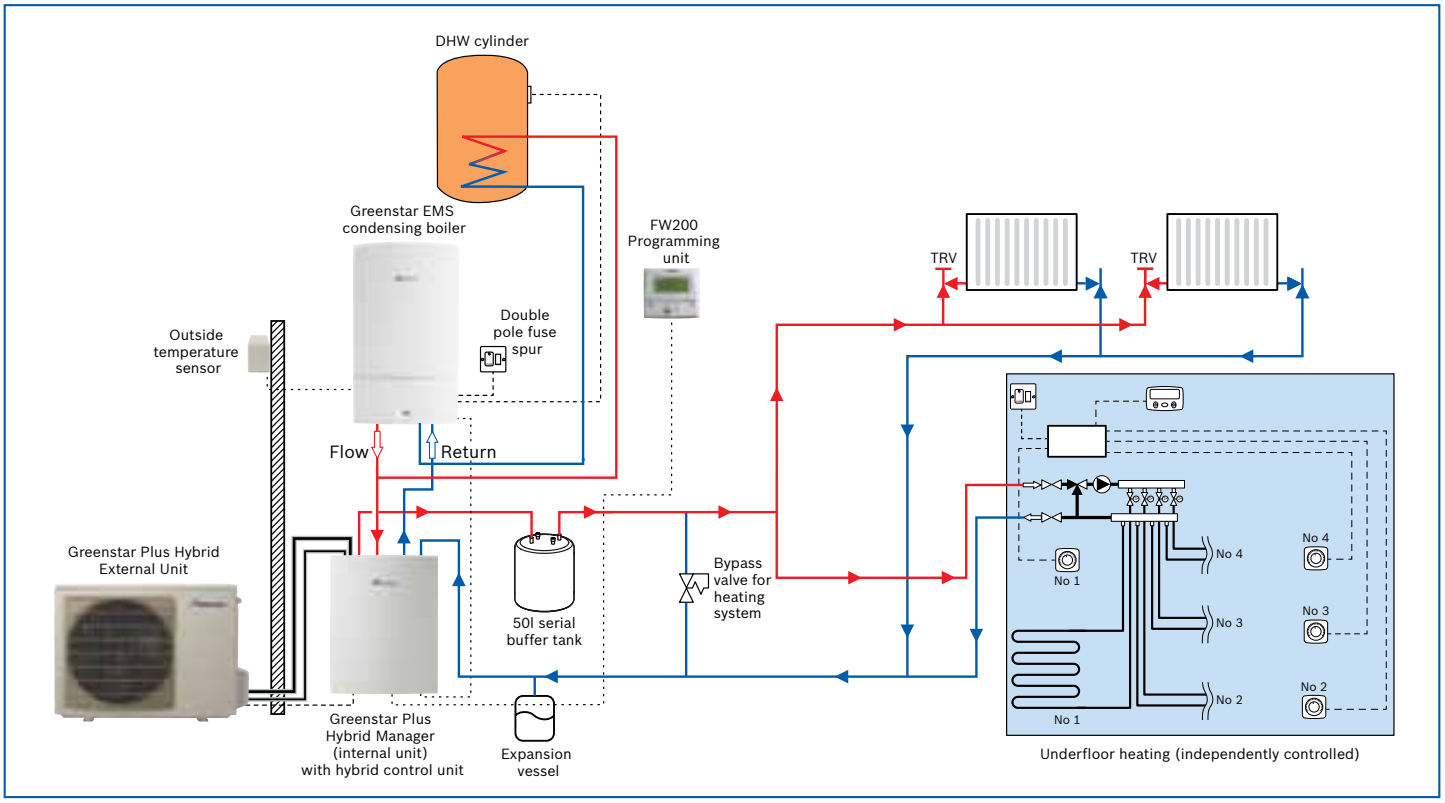
Greenstar Plus Hybrid with system boiler, DHW cylinder, serial buffer tank, bypass valve and unmixed heating circuit



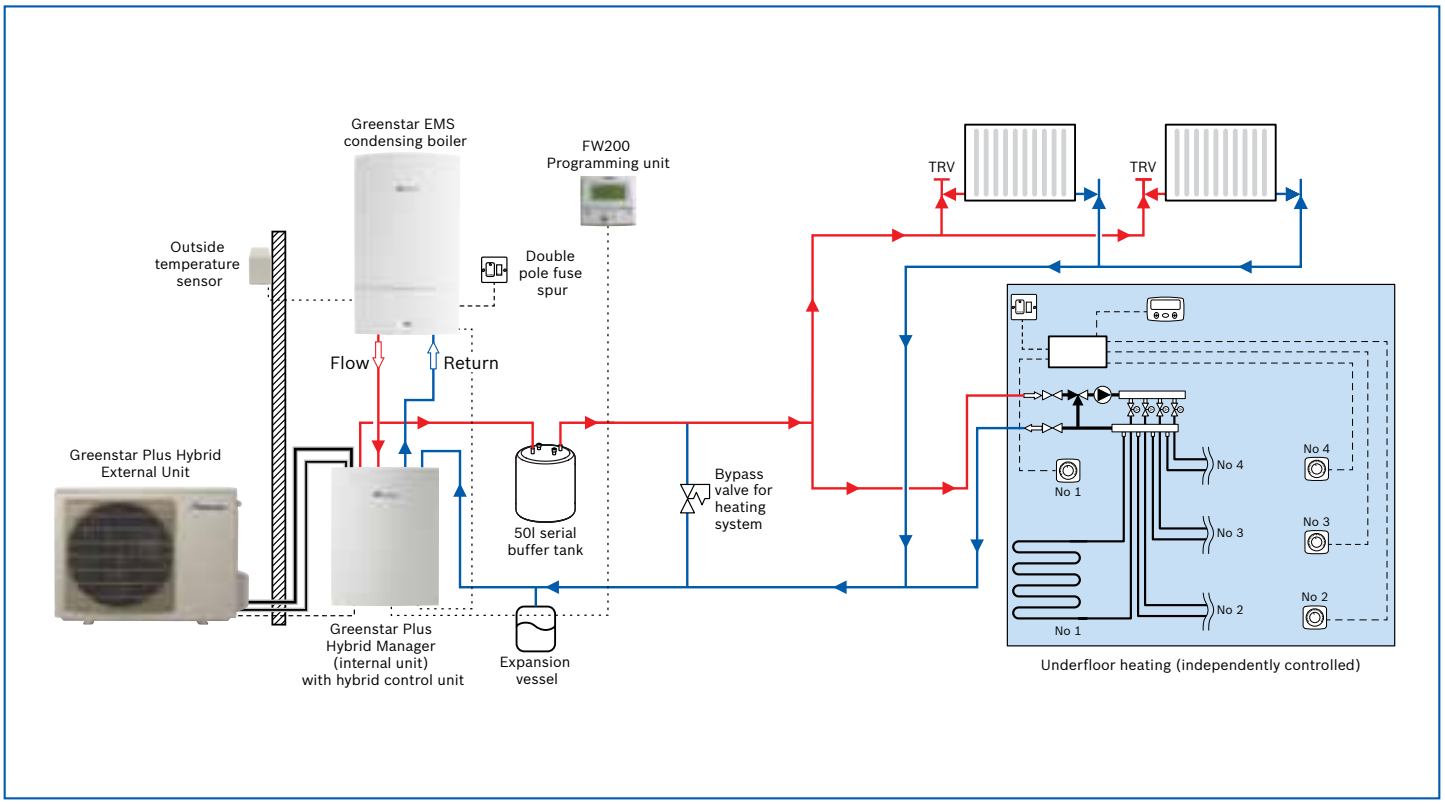
Greenstar Plus Hybrid with combi boiler, serial buffer tank, bypass valve and unmixed heating circuit



Greenstar Plus Hybrid with system boiler, DHW cylinder, serial buffer tank, bypass valve, unmixed heating circuit and independently controlled mixed heating circuit



Greenstar Plus Hybrid with combi boiler, serial buffer tank, bypass valve, unmixed heating circuit and independently controlled mixed heating circuit



Greenstar Plus Hybrid External Unit

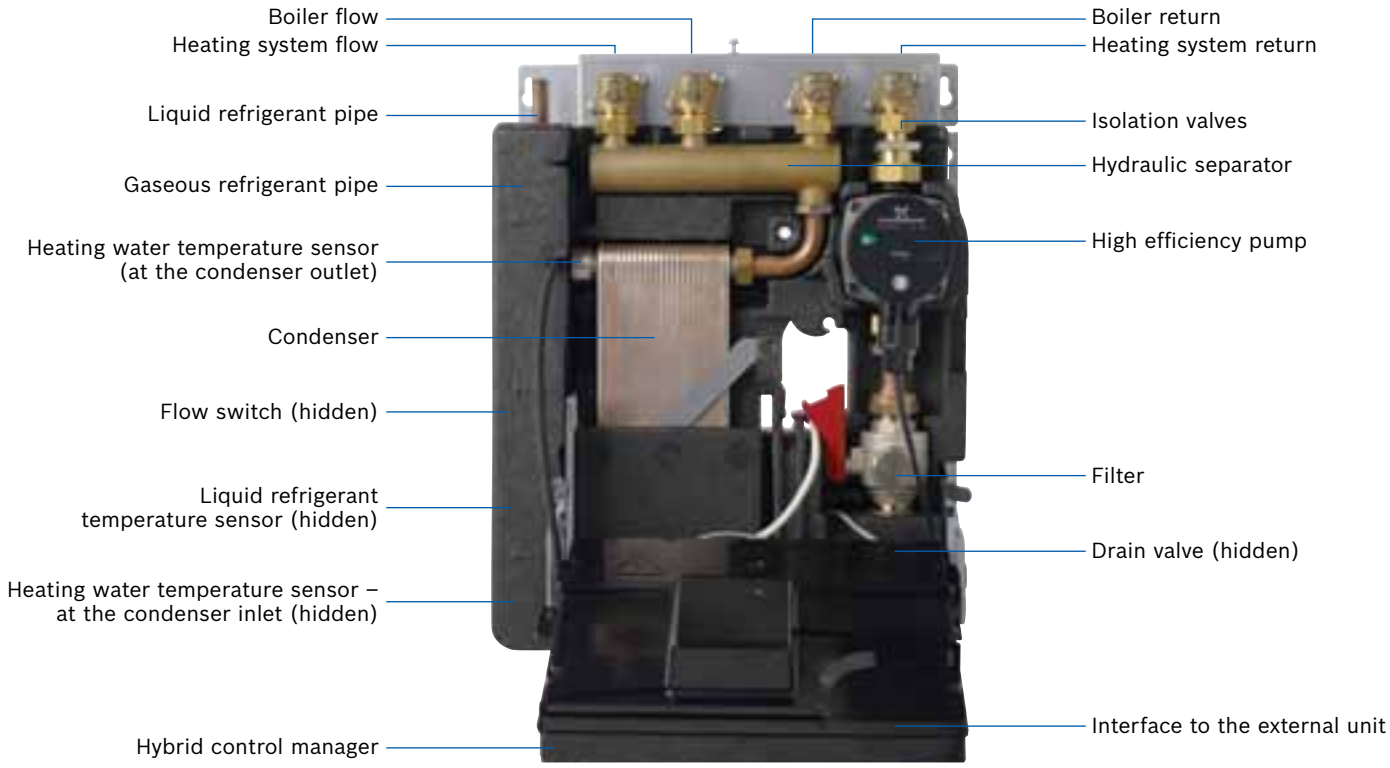
Technical data

	Greenstar Plus Hybrid External Unit
Part No.	7 716 160 021
Height	600mm
Width	800mm
Depth	300mm
Weight – lift	42kg
Mains power supply	230V, 1PH AC 50Hz
Maximum heating output (A2W35)[1)]	4.61kW/2.78 CoP
Rated heating output (A2W35)[1)]	3.85kW/3.14 CoP
Rated heating output (A7W35)[1)]	4.70kW/4.42 CoP
Maximum heating output (A7W35)[1)]	6.08kW/4.11 CoP
Rated heating output (A7W35)[1)]	2.99kW/2.31 CoP
Maximum current	13A
Recommended MCB/fuse rating	16A MCB type D
IP rating	IP24
Refrigerant filling	2.5kg
Air flow rate	35m^3/min
Sound pressure level to EN 12102[2)]	46dB(A)
Outside air temperature operating range	-9 to +21ºC
Water flow temperature operating range	+20 to +50ºC
Maximum line length/height difference	30m/30m
Pipework for liquid refrigerant external diameter	¼"
Pipework for gaseous refrigerant external diameter	½"

1) Reference conditions: to EN 14511-2:2007

2) Measured at a horizontal distance of 1m and a height of 1.5m taken from the appliance bottom

Greenstar Plus Hybrid Manager



Technical data

	Greenstar Plus Hybrid Manager
Part No.	7 716 160 030
Maximum power consumption	50W
Height	500mm
Width	390mm
Depth	360mm
Weight – lift	21kg
Mains power supply	3 A
IP rating	IPX4D
Water content	1.4l
Water flow rate range	6 to 20 l/min

Greenstar Plus Hybrid FW200 weather compensation controller

Symbols	
23.5°C	Current room temperature
	Flashing segment: current time (09:30 to 09:45)
	Solid segments: Time set for operating mode ☼ = Comfort today (1 segment = 15 min)
	Empty segments: Time set for operating mode ☾ = Economy today (1 segment = 15 min)
	No segments: Time set for operating mode ❄ = Frost today (1 segment = 15 min)
☼	Operating mode Comfort for heating circuit
☾	Operating mode Economy for heating circuit
❄	Operating mode Frost for heating circuit
	Automatic mode for heating circuit

	Holiday mode
	Burner operation on display for heating circuit 1
+	Scroll menu/info text up or increase value
−	Scroll menu/info text down or decrease value
OK	Open menu, confirm setting/value or switch heating circuit
	Return to next menu up
	Delete/reset value
advance	Brings forward the next switching time and the associated operating mode
advance	Activate DHW heating immediately

Functional description of the Greenstar Plus Hybrid Manager

The Greenstar Plus Hybrid Manager monitors the heat pump, the condensing boiler and the FW200 weather compensation controller. Subject to outside temperature, heating water flow and return temperature and the primary flow temperature set point, the Hybrid control manager determines what proportion of the total energy demand should be covered by the condensing boiler and the heat pump respectively. This process optimises the efficiency of the heating system.

Greenstar Plus Hybrid Manager

The Greenstar Plus Hybrid Manager delivers the control signal at the interface to the air to water heat pump. This modulates the output of the heat pump subject to the current heat demand.

Hydraulic separator

A hydraulic separator is integrated into the Greenstar Plus Hybrid Manager and separates the condensing boiler and heating circuits. Thus, the heating water, after flowing through the Greenstar Plus Hybrid Manager, can be either routed through the condensing boiler or returned into the heating system.

High efficiency pump within the Greenstar Plus Hybrid Manager

An integrated high efficiency low energy circulation pump (LECP) provides the heating water circulation through the Hybrid Manager. The hydraulic separator also enables the high efficiency pump operation in the Hybrid Manager when the pump inside the condensing boiler is not running.

The pump inside the condensing boiler and the high efficiency pump in the Hybrid Manager run simultaneously if the condensing boiler operates on its own or at the same time as the air to water heat pump.

If only the air to water heat pump is in operation, then only the high efficiency pump in the Hybrid Manager runs.

The heat exchange between the refrigerant (R410A) and the heating water takes place inside the condenser.

The filter, which should be checked regularly, protects the condenser inside the Hybrid Manager and the heating system from contamination through small particles with a diameter larger than 1mm.

Magnetic reed flow switch

A magnetic reed flow switch ensures that the external unit operates only if the water flow rate is adequate for the condenser.

Temperature sensors

Temperature sensors are located at the plate heat exchanger inlet and outlet to protect the heating water from excessively high temperatures during heating operation by the heat pump and against freezing when the heat pump is being defrosted. The heat transfer between the refrigerant (R410A) and the outside air takes place inside the heat exchanger of the external unit (evaporator).

Buffer tank

The 50l buffer tank provides two functions: Firstly, the buffer tank ensures that there is always sufficient heat energy within the heating system in order to support the Heat Pump Defrost operation. Secondly, the buffer volume prevents excessive heat pump cycling during low heat load conditions. This optimises system efficiency and reduces excessive wear on heat pump components.

Is a Greenstar Plus Hybrid system suitable for the property?

It is essential that Hybrid systems are designed to operate efficiently in order to meet the building heating needs and the expectations of the customer. In order to achieve this, the following design activities must be completed prior to the installation:–

- ***Pre-design assessment***
  Pre-requisite: Determining the suitability of a Hybrid system for the building based on the customer's requirements, expectations and building type.
- ***Detailed design***
  Complete building heat loss calculations and domestic hot water usage assessment.
- ***Specification***
  Select the Hybrid system based on the detailed design. Calculate and communicate the predicted energy use and running costs of the system to the customer.

Heat loss

The total heat loss of the property is calculated from the addition of fabric and ventilation heat losses. Fabric heat loss is the transmission of heat by conduction through the building structure, i.e. windows, walls, roof and floor. Ventilation heat loss is heated air escaping from the property and being replaced by cold air from the outside.

Calculating the heat loss of the property

It is essential to accurately calculate the heat loss of the property to ensure correct sizing of the Hybrid system. The heat loss is dependent on the construction of the building, room sizes, external and internal design temperatures and air change rates. The heat loss calculations should satisfy the requirements of BS EN 12831.

Estimating heat loss

Estimating the heat loss of the building is useful in determining the suitability of a Hybrid system. However, assumptions based on floor area (e.g. 50 W/m^2 for new build etc.) and SAP (the Government's Standard Assessment Procedure) should not be used for the detailed design and specification stage. It should be noted that the heat loss for non-standard properties i.e. buildings with large areas of glazing, high ceilings, log burners etc. or properties in exposed locations may deviate significantly from any rules of thumb.

In existing properties, boilers are often oversized and should therefore not be used to determine the actual heat requirements of the house.

However, estimates may be made on the basis of the existing energy consumption of the space to be heated.

This brochure does not cover all the necessary details to calculate the heat loss. The information given here is provided to remind the heating system designer and installer of the process and considerations.

Worcester design service

Worcester's design team offers design support across all of the Worcester, Bosch Group product range. The design team produces technical drawings and provides specification advice for a range of customers; all of our team are authorised SAP assessors and hold an IDHEE Domestic Heating Design Certificate. Worcester provides a range of indemnified design solutions in support of our core range of Greenstar gas- and oil-fired boilers, Greenfloor heating and a growing portfolio of renewable technologies – including Greenskies solar thermal panels as well as Greenstore ground source and Greensource air source heat pumps.

The design service for Worcester Greenstar Plus Hybrid System includes calculations for:

- Estimated annual running costs
- Estimated annual CO_2 savings
- Estimated annual cost savings.

For more information on the suitability of hybrid for your property visit **www.worcester-bosch.co.uk**
For information and guidance on planning permission for split air to water heat pumps visit **www.energysavingtrust.org.uk**

Worcester Greenstar boilers compatible with a Greenstar Plus Hybrid system

Greenstar Si & i System

Greenstar CDi Classic

Greenstar CDi Compact

Greenstar Highflow CDi

Model	Boiler type	Hot water output	Heating outputs	Part no.†
Greenstar 29CDi Classic	Combi	30.9kW	30kW*	7 738 100 216
Greenstar 34CDi Classic	Combi	35kW	30kW*	7 738 100 218
Greenstar 38CDi Classic	Combi	40kW	30kW*	7 738 100 222
Greenstar 42CDi Classic	Combi	42kW	30kW*	7 713 331 019
Greenstar 28CDi Compact	Combi	28kW	24kW	7 716 130 234
Greenstar 32CDi Compact	Combi	32kW	24kW	7 716 130 235
Greenstar 36CDi Compact	Combi	36kW	24kW	7 716 130 236
Greenstar 25Si	Combi	25kW	24kW	7 716 130 139
Greenstar 30Si	Combi	30kW	24kW	7 716 130 140
Greenstar Highflow 440CDi	Combi	29.5kW	29.2kW*	7 715 330 041
Greenstar Highflow 550CDi	Combi	41.1kW	30.6kW*	7 715 330 040
Greenstar 30CDi Classic System	System	–	30kW*	7 712 331 893
Greenstar 12i System	System	–	12kW	7 716 130 143
Greenstar 15i System	System	–	15kW	7 716 130 168
Greenstar 18i System	System	–	18kW	7 716 130 170
Greenstar 24i System	System	–	24kW	7 716 130 144

**Boilers exceeding 25kW can be fitted to the Hybrid System. However, System ΔT will be effected.*
†All part numbers listed are for NG only. However a Hybrid can also be used with LPG.

For further information on our range of Greenstar boilers, including specification and installation requirements, please refer to our dedicated Technical and Specification brochure or call our literature line on **0844 892 9800** to order a copy.

††Greenstar CDi Compact was launched after the 2012 Which? survey.

Installing a Greenstar Plus Hybrid system

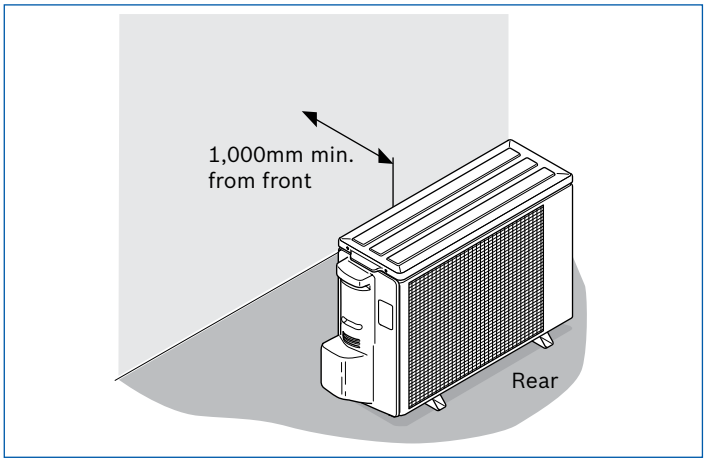
Siting of the external unit

Correct siting, assembly and installation of the individual components are the fundamental requirements for safe and economical operation of the Hybrid system. Installation of the heat pump should be carried out in accordance with MCS/MIS 3005 & MCS 020 Planning Standards.

Foundation

- The installation surface must be level, firm and of appropriate load-bearing capacity. It must be able to bear the weight and absorb the vibrations of the external unit
- Wooden bases are unsuitable installation areas
- Requirements for concrete foundations:
  – Thickness of concrete: ≥120mm
  – Load-bearing capacity: ≥320kg
- Length of fixing screws: ≥70mm (subject to foundation).

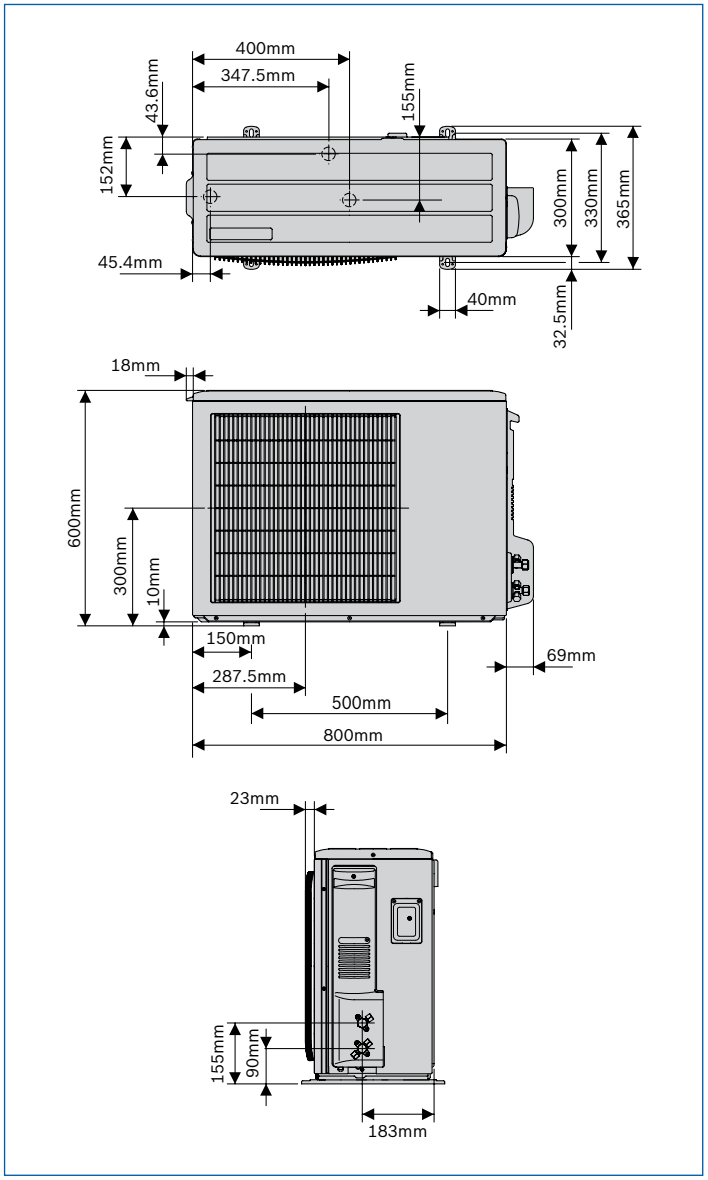
Installation clearances – external unit



Please see the installation manual for further installation clearances when in different locations.

External unit casing dimensions and pipework connections

External unit dimensions



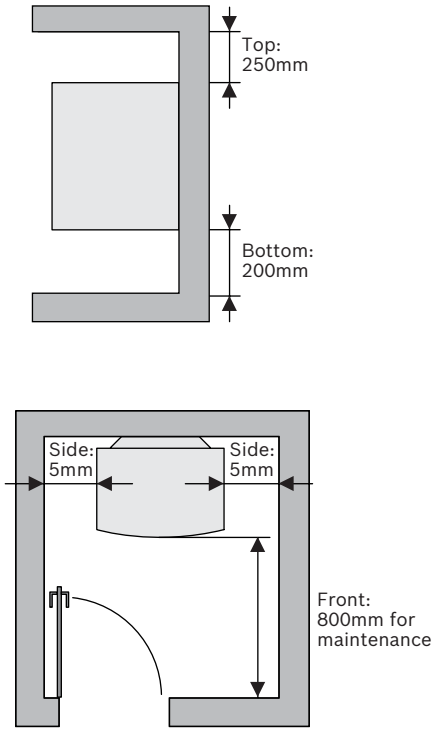
Siting of the indoor unit

Rooms where the Greenstar Plus Hybrid Manager or the refrigerant lines are installed must have an internal volume of at least 5.7m^3, if the room is to be occupied.

- Ensure minimum clearances are maintained
- Mount the Greenstar Plus Hybrid Manager on to a fixed rigid wall capable of supporting the weight of the unit
- To reduce the installation effort we recommend the installation of the Greenstar Plus Hybrid Manager below the boiler
- Flow and return pipes can be routed vertically from the top or bottom into the Greenstar Plus Hybrid Manager
- Refrigerant lines can be routed vertically from the top into the Greenstar Plus Hybrid Manager
- If refrigerant lines are to be routed downwards, allow for adequate space to route the pipes downwards alongside the unit, preferably on the left hand side.

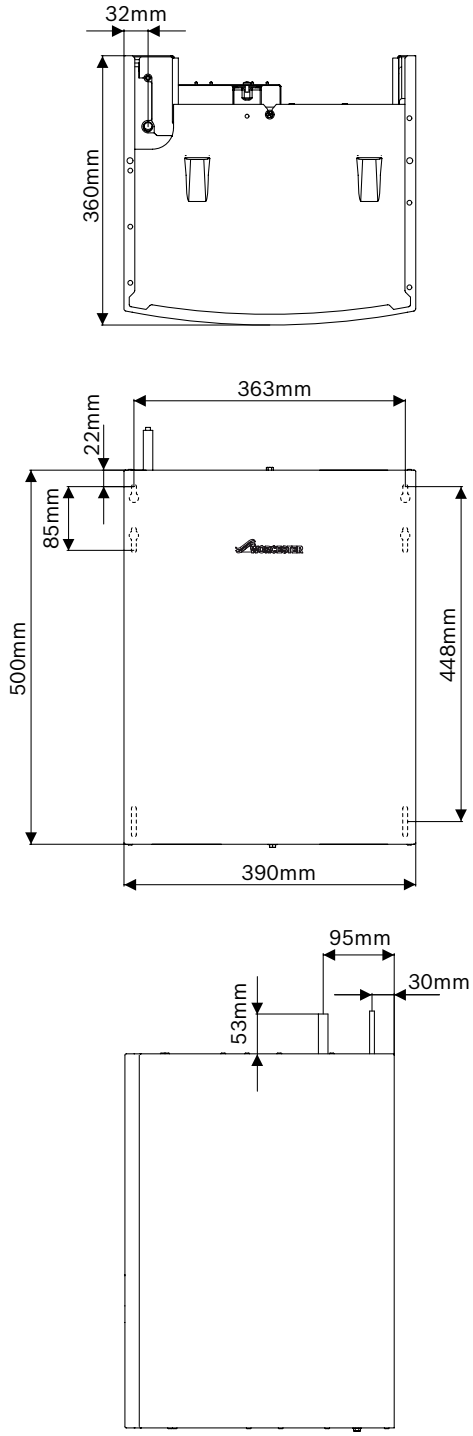
Pipe dimensions	
Flow/return, heating system and additional heat	22mm
Refrigerant pipe gas/liquid, to external unit	½" and ¼"

Installation clearances – Greenstar Plus Hybrid Manager indoor unit



Indoor unit casing dimensions and pipework connections

Greenstar Plus Hybrid Manager indoor unit dimensions



Installation and maintenance

Refrigerants

The Greenstar Plus Hybrid is filled with R410A refrigerant. **Only qualified and authorised refrigeration engineers may work on the refrigerant circuit.** For all work with refrigerant, wear suitable safety gloves and goggles.

Maintenance of the external heat pump

The external unit should be checked regularly for leaves and debris, especially on the evaporation fins and water tray. To prevent damage these must only be cleaned using a watering can with a rose attachment and a soft cloth.

Maintenance on the indoor unit and boiler

These should be serviced annually. If a cylinder is fitted this would have to be serviced annually in accordance with G3 Building Regulations.

Heat emitters

- It is important that a Hybrid system is installed on a system with the appropriate heat emitters for the combination of a heat pump and boiler
- It is recommended a pre-design assessment is carried out to determine the suitability of the system and heat loss calculations for the property are carried out to determine the system design requirements
- If under floor heating is installed the system should be correctly sized to work at lower temperatures.

Designated use

The appliance may only be installed in sealed central heating systems to BS EN 12828. Any other use is considered improper. Any damage that may result is excluded from liability. The commercial and industrial use of the appliance for generating process heat is not permitted.

- Use the appliance exclusively for the stated purpose whilst adhering to the specification and environmental conditions
- The following gas condensing boilers can be used with the Hybrid system:
  - Greenstar 29, 34, 38 and 42 CDi Classic combi
  - Greenstar 25 and 30Si combi
  - Greenstar Highflow 440CDi and 550CDi combi
  - Greenstar 28, 32 and 36CDi Compact combi
  - Greenstar 30CDi Classic System
  - Greenstar 12, 15, 18 and 24i System
- Operate the appliance exclusively with R410A refrigerant.
- Take into account the data on the system component data plates.
- Maximum output of the system is 25kW at ΔT of 20K.

Correct use includes adherence to maintenance and inspection intervals.

The Hybrid system must not be used for purposes other than those specified. Worcester accepts no liability for losses arising from improper, incorrect or unreasonable use.

General information on energy use and heat production

Buildings can be heated efficiently with condensing boilers and air to water heat pumps. However, these two technologies have different performance characteristics.

Condensing boilers as well as air to water heat pumps use energy gained from fossil fuels. In condensing boilers, gas is burnt directly inside the appliance.

Heat pumps use electrical energy which has been obtained from a number of different sources. This includes fossil fuel burning power stations. These are typically around 40 % efficient in converting fuel to useful electricity. Although an air to water heat pump is far more efficient than a condensing boiler at converting its input energy (electricity) into heat, the electricity used has a larger amount of fossil fuel consumption attached. This consumption of fossil fuels is referred to as the **primary energy factor (PEF)**.

The PEF of electricity is generally 2.3, the PEF of oil and gas is 1.1, the PEF of mixed electric power is 2.6. The Coefficient of Performance (CoP) of the heat pump is, subject to outside air temperature and water flow temperature, between 2 and 5.5.

Depending on the current situation and heat demand, either the condensing boiler or the air to water heat pump may offer a more favourable energy-to-cost ratio.

The Hybrid package integrates both technologies in one system and thereby offers the opportunity to use either heat source optimally at any time. Users can decide for themselves whether the emphasis should be on CO_2 emissions or whether costs take priority, alternatively, a combination of CO_2 and costs can be used.

Expansion vessel

An additional expansion vessel must be installed on the heating system return between the bypass valve and the Hybrid Manager. Size the expansion vessel according to BS EN 1282

Installation site in general

- Installation must be in line with MCS MIS 3005 and planning guide MCS 020
- Select an installation site (floor standing or wall mounting) where the heat pump creates no noise nuisance for other occupants or the neighbourhood
- Select an installation site where wiring and pipe work to power source and Hybrid Manager can be easily accomplished
- The heat pump produces condensation during the heating operation. Ensure suitable drainage is provided around the heat pump if such condensation is likely to cause risk of injury or damage
- It is important that flue products or condensate do not drip onto or enter the air intake of the heat pump. Therefore, never locate the heat pump in immediate proximity or directly below the boiler flue outlet.
- Recirculation of the discharge air can severely affect the output
- We recommend a floor standing installation where possible

Windy location

If the heat pump is sited on a roof or other exposed site, ensure that the air discharge is not directly exposed to strong wind.

Possible preventive measures to safeguard against strong wind:

- Direct the air discharge towards the nearest wall. The minimum clearance must be 1,000mm.

Control strategy: CO_2 optimised

The CO_2-optimised mode (factory setting) uses fuel factors to determine when the heat pump or boiler is to be operated to achieve the greatest CO_2 reduction.

The fuel factors for fossil fuel and electricity must be set. The fuel factor indicates the fossil-fuel consumption incurred until the energy (electricity/gas) is available at the corresponding heat appliance. A heat pump uses the input energy more efficiently than a boiler. However, the electricity used generally involves a larger amount of fossil-fuel consumption. The following statement applies to both fuel factors: the lower the values, the better this is for the environment.

Examples:

Electricity from a gas-fired power station that runs at 45% efficiency has a fuel factor of:

- 1/45 % = 1/(45/100) = 1/0.45 = 2.2

Natural gas, which is supplied with a loss of 12% (88% efficiency), has an fuel factor of:

- 1/88 % = 1/(88/100) = 1/0.88 = 1.1

The actual fuel factor for the available energy (electricity/gas) must be checked with the energy supplier.

Installation and maintenance continued

Control strategy: cost optimised

With the cost-optimised mode, the system control decides on the basis of current energy prices. Rising gas prices result in longer operation of the heat pump, whilst rising electricity prices result in longer operation of the boiler.

The cost ratio is the difference between Gross electricity and gas prices converted to Nett.

Example:

- Cost of electricity: 14p/kW
- Cost of gas: 4.5p/kWh

Cost ratio (net): (14/14.5) x 0.902 = 2.8

This is the ratio which must be inputted to the system controller.

The energy:price ratio for electricity and fossil fuel must be adjusted regularly to the actual price ratios.

The Installation, Commissioning and Servicing Instruction Manual includes the weighting factors for different electricity and gas prices.

Spare parts

Only genuine Worcester, Bosch Group spare parts can be used with these products.
Visit your nearest Profile stockist or visit **www.worcester-bosch.co.uk/spares**

Building Regulations and standards

The Hybrid System must be installed and serviced only by a competent person in accordance with the current IEE Regulations, Building Regulations, Building Standards (Scotland) (Consolidation), Building Regulations (Northern Ireland), local water byelaws, Health & Safety Document 63S (The Electricity at Work Regulations 1989), IS 813 (Eire) and other local requirements.

The relevant Standards should be followed, including: BS7074:1: Code of practice for domestic and hot water supply

BS EN:12828: Central heating for domestic premises

BS7593: Treatment of water in domestic hot water central heating systems

BS EN 14511: Requirements for heat pumps for space heating

BS EN 378: Safety and environmental requirements for heat pumps

The Health and Safety at Work Act 1974

The Management of Health and Safety at Work Regulations 1999

The Construction (Health, Safety and Welfare) Regulations 1996

The Construction (Design and Management) Regulations 1994

The Lifting Operations and Lifting Equipment Regulations 1998

Where no specific instruction is given, reference should be made to the relevant codes of practice

Potable water: all seals, joints, compounds (including flux and solder) and components used as part of the secondary domestic water system must be approved for use with potable water supplies

This is to certify that the above ranges of products manufactured by Bosch Thermotechnology Ltd. have been tested and found to comply with:

- the requirements of the (Water Fittings) Regulations 1999 for England and Wales, the Water Byelaws 2000, Scotland and the Water Regulations Northern Ireland

- the requirements of the UK Building Regulations:
  The Building Regulations 1991 (England & Wales) Requirements G3, L1 and Regulation 7.
  The Building Standards (Scotland) Regulations 1990. Regulation 10 (B2), 22 (J3.3a and J3.4), 27 and 28 (P2.6 and P3).
  The Building Regulations (Northern Ireland) 2000.

Commissioning considerations – system flushing and care

Flushing the system

- Fill the system with cold water and check for leaks
- Open all drain cocks and drain the system
- Close drain cocks and add a suitable flushing agent compatible with aluminium at the correct strength for the system conditions and in accordance with the manufacturer‘s instructions.

The pH value of the system water must be in line with BS 7593.

- Circulate the flushing agent before the system is connected
- Run the system at normal operating temperature as directed by the manufacturer of the flushing agent
- Drain and thoroughly flush the system to remove the flushing agent and debris
- It may be necessary to use a power flushing machine to aid the cleansing procedure in some circumstances
- Close the drain cocks and refill with fresh water and a suitable inhibitor
- Vent any air from the boiler and system
- Clean the particle filter.

Filling the heating system

First flush the heating system. If the water heater is connected to the system, it must be filled with clean water. The heating system is then filled.

Filling the heating system with clean water

Worcester recommends fitting the Greenstar System Filter to help ensure that the heating system can perform at its optimum level.

- Set the pre-pressure for the expansion vessel in the premises according to the heating unit's static height
- Open the heating system's valves
- Top up the heating water in the system and fill system to appropriate operating pressure
- Vent the heating system by opening the shut off valve. This may have to be repeated a couple of times and is very important to ensure the correct operation of the system
- Also bleed via the heating system's other bleed valves (e.g. radiators)
- Refill to the correct pressure. Normal pressure is 1.0-2.5bar, but depends on the expansion vessel's pre-pressure and the height of the building
- Shut the heating water filling valve when the correct pressure is reached.

Inhibitor

If the system is exposed to freezing conditions, add a suitable inhibitor or combined inhibitor/anti-freeze in accordance with the manufacturer's guidelines.

The Worcester Greenstar System Filter

Modern boilers and heat pumps are precision engineered and designed to run with a clean water-heating system. Over time, dirty system water will develop, damaging the system and its components, causing failures, shortening the life of the overall system and dramatically reducing its efficiency.

A highly effective solution

The Worcester Greenstar System Filter has been specifically designed to combat the damaging effects of system debris and pollutants, protecting the system for a fraction of its cost.

At the centre of its innovative design is a powerful magnet that removes the magnetic debris that is present in the heating system water. The central location of the magnet ensures that the debris is collected quickly and retained. Any non-magnetic debris is caught by the twin-action cyclonic trap, maximising overall protection.

Greenstar System Filter features and benefits:

- Highly effective – safeguards the system against damage and can save up to 6% a year on energy bills*
- Prevents blockages in radiators – a warmer home and quieter system
- Twin action – effective against magnetic and non-magnetic system debris.

The filter can be fitted under or away from the boiler and heat pump.

Product info	
Part number	7 716 192 609

*Independent research.

Greenstar Plus Hybrid system components

Greenstar Plus Hybrid package

Worcester Part No.
7 716 162 025

Greenstar Plus Hybrid system accessories

Trace heating cable

Worcester Part No.
7 716 161 067

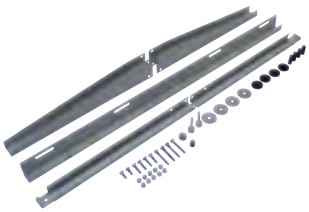
15mm bypass valve

Worcester Part No.
7 716 161 058

Remote control for service

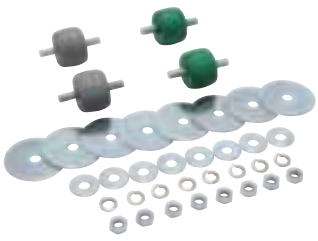
Worcester Part No.
7 716 161 051

Wall mounting frame 80kg



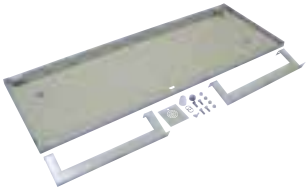
Worcester Part No.
7 716 161 064

Anti-vibration mounts



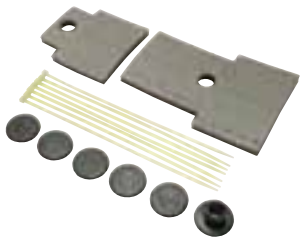
Worcester Part No.
7 716 161 068

External unit drain pan



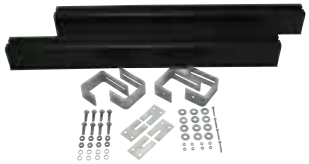
Worcester Part No.
7 716 161 066

External unit drain kit



Worcester Part No.
7 716 161 043

Floor mounting kit



Worcester Part No.
7 716 161 065

The very best training programmes from Worcester

Worcester has always placed great emphasis on technical support and training for installers and service engineers. Advances in heating technology, including the increasing use of renewables, make the need for training greater than ever.

To ensure the highest levels of competence and expertise in the installation of all Worcester products, we run intensive training courses for installers, commissioning engineers and operatives involved with servicing and fault finding.

Courses available

Our training facilities offer a number of courses suitable for the installer and commissioning engineers, and more in-depth courses for the servicing and fault finding engineers.

Training centres throughout the UK

To enable us to meet the growing demand for training we have invested in additional facilities at the award-winning training academy at our Worcester headquarters. In addition to the original academy there is now a new 400m^2 unit, 25% of which is devoted to an open-plan domestic training area with life-size single-storey brick buildings. These feature working Greenskies solar thermal systems which enable installers to get up onto the roof of the building to get more realistic training. There are bays full of all Greenstar gas-fired appliances, so installers can really get to grips with the importance of system design. The additional space also contains dedicated training areas for our renewable and future products. The training centre also runs certified domestic and commercial ACS training and assessment.

Further academies are located at West Thurrock in Essex, Wakefield and Clay Cross in Derbyshire, all offering our full suite of courses. Please phone 01905 752526 for more information about a course near you. Each course is run by specialist trainers and is superbly equipped to deliver a combination of classroom theory and practical hands-on experience that's second to none.

College-linked Learning

As well as offering training at our own centres, Worcester has established close partnerships with many colleges around the UK, equipping them with our latest products. Call us on 01905 752526 to find out when we will be running the course of your choice at a college in your area.

Mobile training

To complement our training venues across the country, we can also bring training to you.

We have mobile vehicles fully equipped with operational Greenstar gas-fired boilers, dry strip-down models and even a Greensource air to air heat pump, ensuring that quality training in a comfortable environment can be achieved on your doorstep!

If it's oil training you require, our 7.5 tonne mobile oil vehicle is available throughout the country for hands-on product training and OFTEC assessments.

Distance learning/web based learning

Worcester has produced a selection of Distance Learning CD ROMs/DVDs which are packed with information. Call 0844 892 9800 for your copies, or visit **www.worcester-bosch.co.uk** for information on Web Based Learning.

Get on course for a more profitable future now.

Call now for more information 01905 752526

Heat pump product courses

All academies allow customers to gain hands-on experience with our entire range of renewable products and inform installers about the true benefits of installing heat pumps and underfloor heating. The introduction to heat pumps course is designed for installers and heating engineers who have no experience in installing heat pumps. The various one day heat pump courses are designed for those with more practical experience in heat pump technology.

Renewable courses

- **Introduction to heat pumps.**
- **Greenstore LECP ground source heat pumps.**
- **Greensource split air to water heat pumps.**
- **Greensource air to water heat pumps.**
- **Greensource air to air heat pumps.**
- **Greenstar Plus Hybrid system.**
- **Renewable range overview.**

	Intro to heat pumps	GSHP	Split AW	AWHP	AAHP	Hybrid	Renewable Overview
Duration	1 Day	1 Day	1 Day	1 Day	1 Day	1 Day	1 Day
Cost	£65	£65	£65	£65	£65	£65	£65
Training course covers							
Specification	✔	✔	✔	✔	✔	✔	✔
Installation	✔	✔	✔	✔	✔	✔	–
Commissioning	✔	✔	✔	✔	✔	✔	–
Servicing	✔	✔	✔	✔	✔	✔	–
Maintenance	✔	✔	✔	✔	✔	✔	–
Product overview	✔	✔	✔	✔	✔	✔	✔
System design	✔	✔	✔	✔	✔	✔	–
Course locations							
Worcester	✔	✔	✔	✔	✔	✔	✔
Clay Cross	✔	✔	✔	✔	✔	✔	✔
Wakefield	✔	✔	✔	✔	✔	✔	✔
West Thurrock	✔	✔	✔	✔	✔	✔	✔
College Links*	✔	✔	✔	✔	✔	✔	✔
Mobile*	–	–	–	–	✔	–	–

*Please contact Worcester Training for specific colleges and mobile dates

To complement the above courses, Worcester also runs a **Hot Water Systems and Safety course** and **IDHEE domestic heating design course.** For more information turn to page 25.

Please note: it is recommended that unless you have experience installing/commissioning/servicing heat pumps or have worked previously with heat pump technology, that the one day introduction to heat pumps course be attended before commencing with any specific heat pump product courses.

Additional product and industry training courses

The diversity of products in today's heating industry gives you the opportunity to expand your expertise, whilst offering more choice to your customers. Worcester provides comprehensive training from all its academies on its entire range of technologies.

We are here to provide you with training and assistance for all areas of your business, not just product training. Call us on **01905 752526** to order a full course training brochure or to book yourself onto a training course, alternatively, you can visit **www.worcester-bosch.co.uk/training**

Gas-fired condensing boiler courses

- **Greenstar CDi Classic gas-fired condensing combi boilers.**
- **Greenstar CDi Compact gas-fired condensing combi boilers.**
- **Greenstar Si & i Junior gas-fired condensing combi boilers.**
- **Greenstar system & regular gas-fired condensing boilers** (covers Greenstar Ri, Greenstar CDi Classic Regular, Greenstar FS CDi Regular, Greenstar 30CDi Classic System and Greenstar i System boilers).
- **Greenstar Highflow CDi & FS CDi regular floor standing gas-fired condensing combi and regular boilers.**

Oil-fired product courses

- **Greenstar oil-fired products.**
- **Oil advanced fault finding.**
- **OFTEC 101, 105e and 600a.**

Accessories training courses

- **Greenfloor heating.**
- **Worcester controls.**

Commercial product courses

- **Greenspring CWi47 water heater.**
- **GB162 overview.**
- **GB162 domestic.**
- **GB162 commercial.**
- **Greenstar Heat Distribution Unit.**
- **Commercial ACS training and assessment – CODNCO1.**

Industry focused courses

- **BPEC underfloor heating installation.**
- **Hot water systems & safety.**
- **Chemical water treatment.**
- **Construction skills F-Gas training/ assessment certification.**
- **IDHEE domestic heating design.**
- **Domestic ACS training and assessment – reassessment. CCN1 + 3 appliances.**
- **MCS Made Easy.**

A complete after-sales service

As part of the worldwide Bosch Group, Worcester strives to maintain the highest possible standards of after-sales care.

In addition to the no-nonsense parts and labour guarantee applicable to all Worcester products, you and your customers have the assurance that every Worcester product is manufactured to both the appropriate British and European standards.

Worcester Contact Centre

Should you require support, our award winning Contact Centre team, based at our head office in Worcester, are ready to take your calls. Whatever your query our contact centre operators along with our nationwide team of engineers are ready to help you.

Tel: 0844 892 9900

Opening times

Monday – Friday: 7.00am – 8.00pm
Saturday: 8.00am – 5.00pm
Sunday: 9.00am – 12 noon
Bank Holidays: 8.00am – 4.30pm

TOP 50 CALL CENTRES FOR CUSTOMER SERVICE 2011

OFTEC AWARDS FOR EXCELLENCE 2012

All the technical advice you need

Spares

Genuine replacement parts for all supported Worcester products are readily available from stock, or on a next day delivery basis. Visit our website at www.worcester-bosch.co.uk/**spares** to find your local stockist.

Customer Technical Support

The Worcester Technical Helpline is a dedicated phone line – committed to providing a comprehensive service to complement the brand name and quality of our products. Our experienced team of technical experts provides answers to queries of a technical nature across the entire Worcester range.

Worcester also has a pre-sales department, which provides assistance in selecting a heating system to suit a particular application, along with full guidance on installation. For more information please contact the Technical Helpline or alternatively visit our website where literature can be downloaded at **www.worcester-bosch.co.uk**

Technical

Tel: 0844 892 4010
Fax: 01905 752 741
technical.enquiries@uk.bosch.com

Opening times

Monday – Friday: 7.00am – 8.00pm
Saturday: 8.30am – 4.00pm
Bank Holidays: 8.00am – 4.30pm

Notes

Useful numbers

Sales
Tel: 01905 752640
Fax: 01905 456445

Spare Parts
Tel: 01905 752576
Fax: 01905 754620

Technical Helpline (Pre & Post Sales)
Tel: 0844 892 3366
Fax: 01905 752741
technical.enquiries@uk.bosch.com

Renewables Technical Helpline
Email: renewable.energy@uk.bosch.com
or telephone 0844 892 4010

Training
Tel: 01905 752526
Fax: 01905 752535

Literature
Email: literature@uk.bosch.com
or download instantly from our website
or telephone 0844 892 9800

Customer Service

Engineer Appointments
Email: appointment.worcester@uk.bosch.com
or telephone 0844 892 3000

Enquiries
Email: service.mailbox@uk.bosch.com
or telephone 0844 892 3000

Guarantee Registration
To register your Worcester guarantee,
please visit our website or
telephone 0844 892 2552

Calls to the listed 0844 numbers are charged at up to 3 pence per minute from BT land lines.
Calls from mobiles and some other networks may vary. Calls to and from Bosch Thermotechnology Ltd
may be recorded for training and quality assurance purposes.

www.worcester-bosch.co.uk

In partnership with energy saving trust™

Worcester, Bosch Group is a brand name of Bosch Thermotechnology Ltd.
This leaflet is accurate at the date of printing, but may be superseded and should be disregarded if specification and/or appearances are changed in the interest of continued improvement. The statutory rights of the consumer are not affected.

Part No. 8 716 116 639 A 01/13

Sustainable Forests
Totally Chlorine Free

BBT2944

WORCESTER
Bosch Group
Worcester, Bosch Group,
Cotswold Way, Warndon,
Worcester, WR4 9SW